



Effect on Diesel Fuel Specifications

Property	ASTM Limit	Detroit Diesel	Cummins	Gen49D Effect
Density	Report	0.835-0.855	0.816 - 0.876	None
Flash Point	Min 52°C	Min 52°C	-	None
Viscosity @ 40°C	1.9 - 4.1 cSt	1.9 - 4.1 cSt	1.3 - 5.8 cSt	None
Water & Sediment	Max 0.050 vol%	Max 0.02% Max 10 mg/L	Max 0.05 vol%	None
Ash Content	Max 0.01 wt%	Max 0.01%	Max 0.02 wt%	None
Sulfur - on Road (#2)	Max 0.05 wt%	Max 0.05 wt%	0.5 wt%	None
Cetane Number	Min 40	Min 45	Min 42 >0°C Min 45 <0°C	Increase by 3
Lubricity (HFRR @ 60°C)	Max 520 microns	Max 460 microns	Max 450 microns	Reduces to 370 microns
Copper Strip Corrosion (3 hrs @ 50°C)	Max No. 3	Max No. 3a	Max No. 2	None
Ramsbottom Carbon Residue	Max 0.35 wt%	Max 0.35 wt%	Max 0.35 wt%	None
Distillation Temperature 90% recovery	282 - 338°C	Max 329°C	Curve must be smooth and continuous	None
Aromatic content	Max 35%	-	-	None
Lubricity (SLBOCLE)	-	Min 3100 g	Min 3100 g	Improves
API Gravity	-	34-38		None
Accelerated Storage Stability	-	Max 15 mg/L		Improves
Stability Octel-Starreon F-21	-	Min 70		Improves
Heat Content, BTU/Gal	-	128,500-130,900		None

The above table shows the North American (ASTM D975) diesel fuel specification requirements for on-road low sulfur #2 diesel fuel. The property listed in bold are those required to be met by fuel suppliers at the pump. Gen49D is formulated with components that are already used by diesel fuel refiners/marketers. At the application rate of 0.08% (800 ppm) there will be no adverse effect on any of the ASTM fuel specification properties. The third and fourth columns show the requirements listed by the two engine manufacturers (Cummins and Detroit Diesel).

Detroit Diesel - Overall, the Detroit Diesel Specification requirement follows the ASTM spec very closely. The only exceptions are noted in red. Detroit Diesel separates the requirements for maximum contaminants to a max of 0.02% water and 10 mg sediment/L of fuel. The Gen49D additive contains no water, or sediment so it will not affect this stricter requirement. Detroit Diesel have specified a minimum Cetane number of 45 for fuel in their engines. Fuel suppliers need only provide 40 Cetane fuel per the ASTM Spec. The addition of Gen49D will increase the Cetane Number of the fuel by up to 3 points, helping to meet the DD spec. DD also specify a more stringent requirement for lubricity. The ASTM specification requires a max HFRR wear scar of 520 microns, while DD limits the scar to 460 microns. Again, Gen49D has a lubricity improver that will help meet the tougher spec. Section 5.1.1 of the DD bulletin states that fuels not meeting the lubricity spec may be additized to meet it.

Finally, the Distillation temperature is slightly different, but Gen49D will not affect this result at 0.08%. Interestingly, the DD spec lists an oxidation stability requirement referencing the O-S F-21 (ASSTM D6468) test. Gen49D improves fuel stability significantly when measured using this test.

Section 5.3.3 on Fuel Additives indicates that additives containing metallic or corrosive elements should not be used. Gen49D contains none of these. They recommend testing a mixture with twice the additive

concentration to represent an overdose condition and confirm that it still meets the specifications. Gen49D has been tested at 3 times the application rate without any problems.

Cummins - Cummins states in their bulletin that:

- A cetane improver can be used with low cetane fuels.
- A pour point depressant or flow improver can help with high pour point fuels,
- A wax crystal modifier can help with fuels with high CFPP.
- An anti-icer can help prevent ice formation in wet fuel in cold weather.
- An anti-oxidant or storage stability additive can help with fuel system deposits and poor storage stability.
- A lubricity enhancer can be used to increase the lubricity of fuels so that they meet the requirements.

Gen49D contains each of the above products and will improve the properties without adversely affecting the specification. The Cummins specs in the table are the same as or wider than the ASTM spec with the exception of Cetane number, lubricity and copper corrosion. Gen49D will improve the results for each of these properties. The Cummins CES 60032 is a specification protocol that outlines the performance requirements of a commercial diesel fuel that will reduce the formation of injector deposits, eliminate injector spray hole corrosion, and provide a minimum amount of lubricity. At the keep clean and clean-up treat rate, Gen49D meets or exceeds all Cummins CES 60032 requirements including;

- ✚ L10 Injector Depositing Test (L10-IDT) Pass
- ✚ N14 Pass
- ✚ Elastomer Compatibility
- ✚ Fuel Filter Media Compatibility
- ✚ Fuel Pump Wear and Corrosion
 - ASTM D130 Copper Corrosion
 - ASTM D5001 BOCLE
 - Lubricant Compatibility